Greatly Enhanced Deep Space Mission Data Return Using Very Large DSN Arrays

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Abstract

The Deep Space Network (DSN) can enable greatly enhanced mission data return from deep space missions by implementing very large arrays of relatively small antennas for signal reception. At the same time, the cost per bit of science data return can be reduced by two orders of magnitude compared to today. The vision is to have arrays at each of the three DSN longitudes with aperture and performance equivalent to 100 70-m antennas, within approximately 20 years. Using Ka-band (32 GHz), this would enable data rates 400 to 500 times that achievable by current 70-m antennas using X-band (8 GHz). Alternately, the data rates now achieved at typical Mars distance could be achieved at Pluto. The impact on mapping missions is tremendous. It will be possible for a single mission to map an entire planet, compared to the few percent of the surface that can be mapped by today's missions. Hyper-spectral imaging and high-definition television are also enabled. The baseline system design calls for approximately 3600 antennas, each of 12-m diameter, at each longitude. The antennas would be located at approximately eight widely separated sites at each longitude. This provides weather diversity for Ka-band reception, enabling very high system availability. The site diversity also enables the array to provide the delta-differenced one-way range (delta DOR) data type, which is becoming increasingly important to deep space missions.